General

Title

Overuse of imaging: percentage of children, ages 6 months through 4 years, diagnosed with simple febrile seizure who are evaluated with imaging of the head (CT or MRI) without indications for neuroimaging, including lumbar puncture and complex febrile seizure.

Source(s)

Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC). Basic measure information: overuse of imaging for the evaluation of children with simple febrile seizure. Ann Arbor (MI): Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC); 2016 Jan. 63 p.

Measure Domain

Primary Measure Domain

Clinical Quality Measures: Process

Secondary Measure Domain

Does not apply to this measure

Brief Abstract

Description

This measure is used to assess the percentage of children, ages 6 months through 4 years, diagnosed with simple febrile seizure who are evaluated with imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) without indications for neuroimaging, including lumbar puncture and complex febrile seizure.

The simple febrile seizure must be diagnosed on the day of or within 30 days of imaging. A lower percentage indicates better performance, as reflected by avoiding imaging when it is not indicated.

Rationale

Febrile seizure is one of the most common types of seizure in young children; the prevalence within the

pediatric population in the United States has been estimated to be between 2% and 5% (American Academy of Pediatrics [AAP] Subcommittee on Febrile Seizures, 2011; Dory et al., 2012). Simple febrile seizures are defined as a primary generalized seizure that lasts for less than 15 minutes accompanied by a fever and not recurring within 24 hours. This measure is focused on young children, who are most likely to experience febrile seizures.

Neuroimaging is used to characterize pediatric patients who have experienced a seizure to evaluate for structural abnormalities of the brain that may predispose to future seizures or require surgical intervention. However, the yield of neuroimaging among children with a first febrile seizure is low, and the attendant risks are likely to outweigh the benefits (AAP, 2013; AAP Subcommittee on Febrile Seizures, 2011). Subsequently, evidence-based practice guidelines advise against neuroimaging for children who experience simple febrile seizures (Dory et al., 2012).

Computed tomography (CT) and magnetic resonance (MR) of the brain are radiologic modalities used to create images of internal structures in a slice-by-slice manner. CT uses X-ray radiation (hereafter simply called radiation), and MR uses magnetic fields and radio waves. Rationales for obtaining neuroimaging to characterize seizures include evaluation for suspected focal malformation or tumor; patient and parental anxiety about the potential for an underlying brain abnormality; and legal concerns for a missed diagnosis on the part of health care providers.

The available evidence indicates that CT studies are overused and of low yield in the evaluation of children who have experienced a febrile seizure (Boyle & Sturm, 2013; Hampers et al., 2006; Hardasmalani & Saber, 2012; Kimia et al., 2012; Teng et al., 2006). One of the most worrisome prospects for overuse of neuroimaging relates to the radiation exposure associated with CT scans and the resultant increased risk for malignancy later in life. Overuse has been defined as any patient who undergoes a procedure or test for an inappropriate indication (Lawson et al., 2012). Imaging overuse subjects children to a number of risks (Malviya et al., 2000; Mathews et al., 2013; Pearce et al., 2012; Wachtel, Dexter, & Dow, 2009). Children who undergo CT scans in early childhood tend to be at greater risk for developing leukemia, primary brain tumors, and other malignancies later in life (Mathews et al., 2013; Pearce et al., 2012). Children are also at risk for complications from sedation or anesthesia, which are often required for longer CT imaging sequences and for most magnetic resonance imaging (MRI) studies. These complications include compromised airway, hypoxia leading to central nervous system injury, and death. Additionally, CT and MRI overuse creates cost burdens for the patient, as well as for payers.

Evidence for Rationale

American Academy of Pediatrics (AAP). Choosing Wisely: An initiative of the ABIM Foundation. Ten things physicians and patients should question. [internet]. Philadelphia (PA): American Academy of Pediatrics (AAP); 2013 Feb 21 [accessed 2015 Feb 24].

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Pearce MS, Salotti JA, Little MP, McHugh K, Lee C, Kim KP, Howe NL, Ronckers CM, Rajaraman P, Sir Craft AW, Parker L, Berrington de GonzÃilez A. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. Lancet. 2012 Aug 4;380(9840):499-505. PubMed

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Primary Health Components

Simple febrile seizure; computed tomography (CT); magnetic resonance imaging (MRI); overuse; children

Denominator Description

The denominator is the number of children, ages 6 months through 4 years, diagnosed with simple febrile seizure. See the related "Denominator Inclusions/Exclusions" field.

Numerator Description

The numerator is the number of children, ages 6 months through 4 years, diagnosed with simple febrile seizure who are evaluated with imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) without indications for neuroimaging. See the related "Numerator Inclusions/Exclusions" field.

Evidence Supporting the Measure

Type of Evidence Supporting the Criterion of Quality for the Measure

A clinical practice guideline or other peer-reviewed synthesis of the clinical research evidence

A formal consensus procedure, involving experts in relevant clinical, methodological, public health and organizational sciences

A systematic review of the clinical research literature (e.g., Cochrane Review)

One or more research studies published in a National Library of Medicine (NLM) indexed, peer-reviewed journal

Additional Information Supporting Need for the Measure

Febrile Seizures: Prevalence and Incidence
Febrile seizures primarily affect infants and young children (American Academy of Pediatrics [AAP] Subcommittee on Febrile Seizures, 2011; Teran et al., 2012) with prevalence between 2% to 5% (AAP Subcommittee on Febrile Seizures, 2011; Dory et al., 2012; Shinnar & Glauser, 2002). Among children who have a febrile seizure, about a third will have a recurrent febrile seizure (Annegers et al., 1990; Berg et al., 1990). Approximately two thirds of febrile seizures are simple (i.e., lasting less than 15 minutes without focal features and occurring once in a 24-hour period) (Berg & Shinnar, 1996).

Febrile Seizure Pathology and Severity
In general, a seizure will involve abnormal movements or changes in behavior that occur as a result of uncontrolled electrical activity in the brain (Duvivier & Pollack, 2009). A febrile seizure is defined as a seizure occurring during a fever (temperature greater than or equal to 100.4°F or 38°C, determined by any method), in the absence of a central nervous system infection. The exact relationship between seizure activity and fever has not been determined and is likely multifactorial (Pavlidou & Panteliadis, 2013; Shinnar & Glauser, 2002; Teran et al., 2012). Individuals may be genetically susceptible to febrile seizures. Other predisposing factors that have been proposed include infectious agents and iron insufficiency.

Simple febrile seizures are generally felt to be benign events with little to no increased risk of subsequent epilepsy compared with the general population (AAP Subcommittee on Febrile Seizures, 2011; Shinnar & Glauser, 2002). However, the seizure event generates considerable distress and concern for the family members and caregivers who witness it (Baumer et al., 1981; Shinnar & Glauser, 2002). As a result, parents may seek out emergency medical care or the services of the child's primary care provider.

Despite well-documented and disseminated guidelines regarding the recommendation to refrain from imaging, neuroimaging is overused to evaluate children with febrile seizures (Boyle & Sturm, 2013; Hampers et al., 2006; Hardasmalani & Saber, 2012; Kimia et al., 2012; Teng et al., 2006). Rationales for obtaining neuroimaging to characterize seizures include evaluation for suspected focal malformation or tumor; patient and parental anxiety about the potential for an underlying brain abnormality; and legal concerns for a missed diagnosis on the part of health care providers.

Burdens of Overuse of Imaging for Febrile Seizures: Radiation, Sedation/Anesthesia, and Intravenous Contrast Risks; Cost
The literature offers many examples of the potential risks associated with overuse of imaging. Chief among these are risks related to radiation (Mathews et al., 2013; Pearce et al., 2012), sedation and/or anesthesia (Malviya et al., 2000; Wachtel, Dexter, & Dow, 2009), and intravenous contrast media (Zo'o et al., 2011). Cost is also an issue.

Radiation-Related Burden and Risk. Radiation exposure associated with computed tomography (CT)-

imaging introduces the possibility of chronic health risks related to malignancies sustained from radiation effects (Berrington de González et al., 2009; Mathews et al., 2013; Pearce et al., 2012). Radiosensitive organs—including the brain, bone marrow, lens of the eye, and thyroid gland—can be exposed to radiation during CT of the head (Papadakis et al., 2011). In children younger than 5 years, about 20% of the active bone marrow is in the cranium, compared with 8% in adults (Cristy, 1981). CT-based radiation dose for pediatric patients is highly problematic, because the developing cellular structures and tissues of children are significantly more radiosensitive than those of adults; children, therefore, will be at substantially elevated risk for malignancy (Hayes et al., 2012).

To conduct imaging studies with radiation dosing that is appropriate for children, many facilities follow policies and protocols using the concept of ALARA—as low as reasonably achievable. ALARA principles deem any additional radiation beyond the minimum needed for interpretable images both detrimental and non-efficacious (American College of Radiology [ACR], 2009). Professional practice and patient advocacy groups including the ACR, the American Academy of Neurology (AAN), and the AAP have developed and promoted ALARA protocols and policies; these guidelines support the use of CT imaging only when clinically indicated in children, decreasing the risk of harm from radiation.

Sedation- and Anesthesia-Related Burden and Risk. Some children will require sedation to ensure minimal movement during CT and magnetic resonance imaging (MRI) studies. This use of sedation is necessary to avoid motion artifacts, which interfere with image quality and invariably occur if the child moves during image acquisition. Motion artifacts sometimes undermine imaging quality to the point of rendering images unreadable. In the case of CT imaging, this may result in additional radiation exposure to obtain images sufficient for interpretation. Although the sedation used for pediatric imaging has been identified as low risk, it does have potential attendant complications (Cravero et al., 2006; Malviya et al., 2000). Levels of sedation are on a continuum from minimal anxiolysis (administration of an anxiety reduction agent) to deep sedation, in which the patient can be roused only via vigorous stimuli (Arthurs & Sury, 2013). Compared with minimal sedation, moderate and deep sedation carry a greater risk of airway compromise, hypoxia resulting in central nervous system injury, and death (Cravero et al., 2006).

In certain instances, sedation may not be sufficient, and anesthesia will be required to complete imaging. Anesthesia includes administration of medication to the extent that there is some degree of respiratory suppression and potential for cardiac depression; the patient cannot be roused by external stimuli or commands (Arthurs & Sury, 2013). Administration of anesthesia raises risks related to the process of intubation for respiratory support. These risks include dental trauma; airway edema (swelling of the windpipe); vocal cord spasm or injury; regurgitation of stomach contents with subsequent aspiration (inhalation) pneumonia; injury to arteries, veins, or nerves; alterations in blood pressure; and/or irregular heart rhythms (Society for Pediatric Anesthesia, 2014). The most severe risks, though rare, include brain damage and death (Society for Pediatric Anesthesia, 2014).

Intravenous Contrast-Related Burden and Risk. During the course of CT and MRI studies, intravenous (IV) contrast media may be used to enhance visualization of vascular structures and provide important information about neurologic anatomy. It is possible a child may experience an allergic reaction to IV contrast or subcutaneous fluid leakage (extravasation) during administration of IV contrast. IV contrast administration also includes the risk of contrast-induced nephrotoxicity (CIN) (Bansal et al., 2014; Zo'o et al., 2011). Children with poor kidney function are at greater risk for developing CIN and, in rare cases, will develop renal failure requiring dialysis.

Cost-Related Burden. Overuse of imaging is costly and places additional strain on an already heavily burdened health care system (Callaghan et al., 2014). As an example, charges for a CT of the brain can be as much as $2,000 and can vary substantially by region of the country. In addition, the likelihood that neuroimaging will result in the identification of clinically important structural abnormalities in this patient population is low. Incidental findings, however, may require follow-up testing with associated charges and potential complications (Lumbreras, Donat, & Hernández-Aguado, 2010; Rogers et al., 2013).

Performance Gap

Currently, professional guidelines do not support neuroimaging for simple febrile seizures (AAP Subcommittee on Febrile Seizures, 2011; Dory et al., 2012) because the yield of neuroimaging among

children with a first febrile seizure is low, and the attendant risks are likely to outweigh the benefits (AAP Subcommittee on Febrile Seizures, 2011).

Drivers of Overuse

Febrile seizures can be a stressful event that may prompt a parent to seek the assistance of a health care provider, at times emergently. Some providers may feel pressured by the parent to order imaging despite a lack of benefit (Dory et al., 2012). This circumstance has a close parallel with parents who seek antibiotics for a child who has viral respiratory symptoms. In these circumstances, the provider may deviate from established practice guidelines to placate the parent. In recent decades, this phenomenon has reached such widespread prominence as to prompt multidisciplinary initiatives targeted at fostering discussion and identifying common practices that should be questioned by parents and providers (AAP, 2013). For example, the list of practices that parents should question, posited by the AAP (2013) as part of its Choosing Wisely initiative, includes guidance to discourage the unnecessary use of CT scans for the immediate evaluation of simple febrile seizures. An ongoing dialogue between providers and parents about the need for imaging continues to be a key feature of optimal outcomes for children with seizures.

The practice of defensive medicine is another reason an imaging study may be ordered. Physicians may be uncomfortable facing uncertainty regarding the etiology of seizure in children they are evaluating and treating. Assurance behaviors (e.g., ordering additional tests) are expected when a malpractice-sensitive physician is faced with a potentially worrisome condition that can cause the symptom in question (Carrier et al., 2013). In a survey of physicians from six specialties at high risk of liability, emergency physicians ordered more unnecessary diagnostic tests than clinicians from any other specialty (Studdert et al., 2005). Physicians practicing in the emergency department have the added challenge of limited access to detailed medical records, which increases uncertainty about prior evaluation of patients who are referred from an out-of-network provider or hospital. Overuse of neuroimaging is a potential result.

See the original measure documentation for additional evidence supporting the measure.

Evidence for Additional Information Supporting Need for the Measure

American Academy of Pediatrics (AAP). Choosing Wisely: An initiative of the ABIM Foundation. Ten things physicians and patients should question. [internet]. Philadelphia (PA): American Academy of Pediatrics (AAP); 2013 Feb 21 [accessed 2015 Feb 24].

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Extent of Measure Testing

Reliability

This measure was tested using inter-rater reliability (IRR) of medical record data, as described below.

Abstracted Medical Record Data. Medical record data were obtained through HealthCore, Inc., an independent subsidiary of Anthem, Inc., the largest health benefits company/insurer in the United States. HealthCore owns and operates the HealthCore Integrated Research Database (HIRD), a longitudinal database of medical and pharmacy claims and enrollment information for members from 14 geographically diverse Blue Cross and/or Blue Shield (BCBS) health plans in the Northeast, South, West, and Central regions of the United States, with members living in all 50 states. The HIRD includes automated computerized claims data and enrollment information for approximately 60 million lives with medical enrollment, over 37 million lives with combined medical and pharmacy enrollment information, and 16 million lives with outpatient laboratory data from the BCBS licensed plans.

This measure belongs to the Quality Measurement, Evaluation, Testing, Review and Implementation Consortium (Q-METRIC) *Overuse of Imaging for the Evaluation of Children with Headache or Seizures* measures collection. As part of the initial sampling strategy for testing multiple measures in this collection, approximately 2.1 million children, ages 6 months through 17 years old, were identified in the HIRD for the study's 2012 measurement year. Of these, a cohort of children with diagnosis codes for headaches and seizures were identified (57,748). This initial sample included a broader set of children from 6 months to 17 years of age; for the purposes of testing this measure, members who did not have continuous eligibility during the 2011 and 2012 calendar years were excluded, narrowing the group to 36,985. Specifically for this measure, administrative claims were used to determine the number of children 6 months through 4 years of age who had a diagnosis of febrile seizure (470, 1.3%).

Providers associated with the eligible children's visits were identified; the final sampling population consisted of 413 children (87.9%) who were linked to a provider with available contact information. Once subjects were identified, patient medical records were requested from provider offices and health care facilities; records were sent to a centralized location for data abstraction. To ensure an adequate number of cases to test the feasibility of this measure, we set a target sample of 200 abstracted charts.

Trained medical record abstractors reviewed paper copies of the medical records and entered data collected into a password-protected database. To help ensure consistency of data collection, the medical record abstractors were trained on the study's design and presented with a standardized data collection form designed to minimize the need to make subjective judgments during the abstraction process. In addition, data were entered onto forms, which were subsequently scanned and reviewed through a series of quality checks.

In total, 191 charts were reviewed for the presence of denominator exclusions that were not present in claims. There were 107 children (56.0%) with documentation of a condition that met denominator exclusion within the chart, resulting in a total of 84 children (44.0%) who met denominator criteria for this measure. Among patients eligible for the denominator, imaging was obtained without a documented indication within the medical chart for two children (2.4%).

Inter-Rater Reliability (IRR). Reliability of medical record data was determined through re-abstraction of patient record data to calculate the IRR between abstractors. Broadly, IRR is the extent to which the abstracted information is collected in a consistent manner. Low IRR may be a sign of poorly executed abstraction procedures, such as ambiguous wording in the data collection tool, inadequate abstractor training, or abstractor fatigue. For this measure, the medical record data collected by three abstractors was individually compared with the data obtained by a senior abstractor. Any differences were remedied by review of the chart. IRR was determined by calculating both percent agreement and Cohen's kappa statistic.

Of the 191 medical records received for chart review, 30 records (15.7%) were reviewed for IRR. IRR was assessed by comparing abstractor agreement with a senior abstractor on nine data elements included in the chart abstraction form for this measure. Overall, abstractor agreement was 100%; the kappa statistic

was 1.0, indicating that a perfect level of IRR was achieved. Given this evidence, the data elements needed for calculation of the measure can be abstracted from medical records with a high degree of accuracy.

Validity
Face Validity. The face validity of this measure was established by a national panel of experts and parent representatives for families of children with headaches and seizures convened by Q-METRIC. The Q-METRIC panel included nationally recognized experts in the area of imaging children, representing general pediatrics, pediatric radiology, pediatric neurology, pediatric neurosurgery, pediatric emergency medicine, general emergency medicine, and family medicine. In addition, face validity of this measure was considered by experts in state Medicaid program operations, health plan quality measurement, health informatics, and health care quality measurement. In total, the Q-METRIC imaging panel included 15 experts, providing a comprehensive perspective on imaging children and the measurement of quality metrics for states and health plans.

The Q-METRIC expert panel concluded that this measure has a high degree of face validity through a detailed review of concepts and metrics considered to be essential to appropriately imaging children. Concepts and draft measures were rated by this group for their relative importance. This measure was highly rated, receiving an average score of 7.7 (with 9 as the highest possible score).

Refer to the original measure documentation for additional information.

Evidence for Extent of Measure Testing

Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC). Basic measure information: overuse of imaging for the evaluation of children with simple febrile seizure. Ann Arbor (MI): Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC); 2016 Jan. 63 p.

State of Use of the Measure

State of Use

Current routine use

Current Use

not defined yet

Application of the Measure in its Current Use

Measurement Setting

Ambulatory/Office-based Care

Ambulatory Procedure/Imaging Center

Emergency Department

Hospital Outpatient

Managed Care Plans

Professionals Involved in Delivery of Health Services

not defined yet

Least Aggregated Level of Services Delivery Addressed

Single Health Care Delivery or Public Health Organizations

Statement of Acceptable Minimum Sample Size

Specified

Target Population Age

Age 6 months to 4 years

Target Population Gender

Either male or female

National Strategy for Quality Improvement in Health Care

National Quality Strategy Aim

Better Care

National Quality Strategy Priority

Making Care Safer
Prevention and Treatment of Leading Causes of Mortality

Institute of Medicine (IOM) National Health Care Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Safety

Data Collection for the Measure

Case Finding Period

The measurement year

Denominator Sampling Frame

Enrollees or beneficiaries

Denominator (Index) Event or Characteristic

Clinical Condition

Patient/Individual (Consumer) Characteristic

Denominator Time Window

not defined yet

Denominator Inclusions/Exclusions

Inclusions
The denominator is the number of children, ages 6 months through 4 years, diagnosed with simple febrile seizure.

Note:

Eligible children are ages 6 months through 4 years during the measurement year, January 1 through December 31, and must be continuously enrolled in their same health plan during the measurement year, and the year prior to the measurement year. Children younger than 2 years during the measurement year must be continuously enrolled from birth through the end of the measurement year.
Eligible children are restricted to those diagnosed with simple febrile seizure (a primary generalized seizure that lasts for less than 15 minutes, accompanied by fever, and does not recur within 24 hours). Refer to Table 2 in the original measure documentation for International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes to identify simple febrile seizure.

Exclusions

- Exclusions based on ICD-9-CM codes captured in administrative claims data:
  - Afebrile seizure (refer to Table 2 of the original measure documentation) on the day of or within the 365 days before the first simple febrile seizure in the measurement year
  - Medical conditions that would warrant imaging (refer to Tables 4-9 of the original measure documentation) diagnosed on the day of or within the 365 days before the simple febrile seizure
  - Lack of expected normal physiological development (ICD-9-CM code 783.40) or delayed milestones (ICD-9-CM code 783.42) within the 365 days before the simple febrile seizure
  - Signs or symptoms of increased intracranial pressure (refer to Table 10 of the original measure documentation) between the date of the simple febrile seizures diagnosis and the imaging study
- Exclusions based on clinical documentation:
  - Afebrile seizure
  - Medical conditions that would warrant imaging
  - Developmental delay, lack of normal physiological development, or delayed milestones
  - Family history of seizures
  - Signs or symptoms of increased intracranial pressure
  - Abnormal neurologic exam

Exclusions/Exceptions

not defined yet

Numerator Inclusions/Exclusions

Inclusions
The numerator is the number of children, ages 6 months through 4 years, diagnosed with simple febrile seizure who are evaluated with imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) without indications for neuroimaging.

Note: CT or MRI must be obtained within 30 days of the simple febrile seizure diagnosis. Refer to Table 1 of the original measure documentation for Current Procedural Technology (CPT) codes associated with brain imaging (CT or MRI).

Exclusions
Exclusions based on clinical documentation:

- *Complex* febrile seizure
- Lumbar puncture (spinal tap) (refer to Table 3 of the original measure documentation)

Numerator Search Strategy

Fixed time period or point in time

Data Source

Administrative clinical data

Electronic health/medical record

Paper medical record

Type of Health State

Does not apply to this measure

Instruments Used and/or Associated with the Measure

Unspecified

Computation of the Measure

Measure Specifies Disaggregation

Does not apply to this measure

Scoring

Rate/Proportion

Interpretation of Score

Desired value is a lower score

Allowance for Patient or Population Factors

not defined yet

Standard of Comparison

not defined yet

Identifying Information

Original Title

Overuse of imaging for the evaluation of children with simple febrile seizure.

Measure Collection Name

Overuse of Imaging for the Evaluation of Children with Headache or Seizures

Submitter

Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC) - Academic Affiliated Research Institute

Developer

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Financial Disclosures/Other Potential Conflicts of Interest

Unspecified

Adaptation

This measure was not adapted from another source.

Date of Most Current Version in NQMC

2016 Jan

Measure Maintenance

Unspecified

Date of Next Anticipated Revision

Unspecified

Measure Status

This is the current release of the measure

Measure Availability

Source available from the Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC) Web site . Support documents also available from the Q-METRIC Web site .

For more information, contact Q-METRIC at 300 North Ingalls Street, Room 6C06, SPC 5456, Ann Arbor, MI 48109-5456; Phone: 734-232-0657.

NQMC Status

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Copyright Statement

Production

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